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WHAT IS CLAIMED IS:

1. A gravity meter, comprising:

a laser for generating a light beam;

an optical fiber having a first end in light communication with the laser and a second end, wherein the second end of the fiber establishes a fixed reflector for reflecting a first portion of the light beam back through the optical fiber and for permitting a second portion of the light beam to propagate through the fixed reflector;

a seismometer mass for holding the fixed reflector to attenuate the propagation of vibrations to the fixed reflector;

a droppable reflector in light communication with the second end of the fiber for reflecting the second portion of the first beam back through the optical fiber; and

a detector in light communication with the first and second portions of the light beam for detecting interference fringes generated by the interaction between the first and second portions of the light beam,

~~wherein the interference fringes are representative of the displacement of the droppable reflector relative to the fixed reflector.~~

2. The gravity meter of claim 1, further comprising an evacuated chamber, wherein the droppable reflector is positioned in the evacuated chamber.

~~3. The gravity meter of Claim 2, further comprising an elevator for holding the droppable reflector, wherein the elevator can be distanced from the droppable reflector to cause the droppable reflector to fall, and wherein the elevator gradually decelerates to gently contact the droppable reflector.~~

G 3 ~~4.~~ The gravity meter of Claim 2 ~~3~~, further comprising a computer for controlling the elevator and for determining gravitational acceleration based upon the interference fringes.

4 ~~5.~~ The gravity meter of Claim 3 ~~4~~, further comprising a waveform digitizer electrically connected to the computer for sampling the interference fringes at a predetermined sampling frequency.

5 ~~6.~~ The gravity meter of Claim 4 ~~5~~, further comprising a beam collimator disposed adjacent the second end of the fiber for collimating light and a pressure vessel for holding the laser and reflectors, the pressure vessel including a center ring, a bottom, and a plurality of levelling legs attached to the center ring.

6 ~~7.~~ The gravity meter of Claim 5 ~~6~~, wherein the levelling legs include respective lead screws disposed in respective cylinders, each lead screw being reciprocatingly disposed in its associated cylinder for adjusting the orientation of the pressure vessel with respect to the earth.

7 ~~8.~~ The gravity meter of Claim 6 ~~7~~, wherein the elevator is coupled to the center ring, the bottom of the pressure vessel includes a resilient surface, and the seismometer mass is mounted on the resilient surface.

9 ~~10~~. The apparatus of Claim 8 ~~9~~, wherein the optical fiber is formed with an end for establishing the first reflector, the light source is a laser, and the apparatus further comprises a seismometer mass for holding the end of the optical fiber to attenuate the propagation of vibrations through the mass to the end.

~~11. The apparatus of Claim 10, wherein the light processor includes a photon detector and a computer electrically connected to the detector.~~

~~12. The apparatus of claim 11, further comprising an evacuated chamber for holding the second reflector and an elevator for holding the second reflector, wherein the computer controls the elevator and determines gravitational acceleration based upon the interference fringes.~~

11 ~~13~~. The apparatus of Claim 11 ~~12~~, further comprising a waveform digitizer electrically connected to the computer for sampling the interference fringes at a predetermined sampling frequency.

13 ~~14~~. The apparatus of Claim 12 ~~13~~, further comprising a beam collimator disposed adjacent to the end of the fiber for collimating light and a pressure vessel for holding the laser and reflectors, the pressure vessel including a center ring, a bottom, and a plurality of levelling legs attached to the center ring,

wherein the levelling legs include respective lead screws disposed in respective cylinders, each lead screw being reciprocatingly disposed in its associated cylinder for adjusting the

orientation of the pressure vessel with respect to the earth, and wherein the elevator is coupled to the center ring, the bottom of the pressure vessel includes a resilient surface, and the second reflector is mounted on the resilient surface.

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~~15.~~ A portable gravity meter for determining the acceleration of an object due to gravity, comprising:

a portable housing;

a laser mounted in the housing; and

an interferometer mounted in the housing, the interferometer including:

(a) a movable reflector mounted in the housing such that the movable reflector can be accelerated by gravity;

(b) a fixed reflector mounted in the housing in a stationary relationship therewith; and

(c) an optical guide establishing a first optical path between the laser and the movable reflector and a second optical path between the laser and the fixed reflector, wherein vibrations affecting the first optical path affect the second optical path equally.

15 ~~16~~. The gravity meter of Claim 14 ~~15~~, wherein the optical guide includes an optical fiber having a first end in light communication with the laser, a second end establishing the fixed reflector, and a ferrule positioned in a surrounding relationship with the second end.

16 ~~17~~. The gravity meter of Claim 15 ~~16~~, wherein the optical guide further includes a collimating lens positioned between the movable reflector and the ferrule.

17 ~~18~~. The gravity meter of Claim 16 ~~17~~, further comprising a seismometer mass for holding the ferrule to isolate the ferrule and the second end of the optical fiber from vibrations.

18 ~~19~~. The gravity meter of Claim 17 ~~18~~, wherein light reflected from the movable reflector propagates along the first optical path through the optical fiber, light reflected from the fixed reflector propagates along the second optical path through the optical fiber, and the reflected light from the movable reflector interferes with the reflected light from the fixed reflector to thereby generate interference fringes representative of gravitational acceleration.

19 ~~20~~. The gravity meter of Claim 18 ~~19~~, further comprising a photon detector mounted in the housing and a beam splitter connected to the optical fiber for directing the interference fringes toward the detector.

20 ~~21~~. The gravity meter of Claim 19 ~~20~~, wherein the movable reflector is a corner cube retroreflector.

21 ~~22~~. The gravity meter of Claim 20 ~~21~~, further comprising a computer for determining gravitational acceleration based upon the interference fringes.

~~23~~ 22. A method for determining gravitational acceleration, comprising the steps of:

(a) directing a laser beam against movable and fixed reflectors such that light reflected from one reflector interferes with light reflected from the other reflector to thereby generate an interference fringe pattern;

(b) generating an electrical signal representative of the fringe pattern;

(c) sampling the electrical signal at a constant predetermined sampling frequency to generate a sampled signal; and

(d) determining gravitational acceleration based upon the sampled signal.

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9. An apparatus comprising:

a light source for generating a light beam;

an optical fiber optically coupled to the light source for transmitting the light beam;

a first reflector for reflecting the light beam from the optical fiber, the first reflector being positioned such that no relative motion occurs between the first reflector and the optical fiber;

a second reflector for reflecting the light beam from the optical fiber, wherein the second reflector can be selectively accelerated under the influence of gravity relative to the first reflector, and wherein reflected light from the second reflector interferes with reflected light from the first reflector to generate interference fringes; and

a light processor positioned for receiving the interference fringes and determining the magnitude of the acceleration of the second reflector relative to the first reflector in response thereto.

~~24. A method for determining gravitational acceleration based upon an interference fringe pattern, comprising the steps of:~~

~~detecting points of the fringe pattern, wherein each detected point is separated from its immediately adjacent points by a constant predetermined time period; and~~

~~iteratively fitting the points to a sinusoidal function representative of gravitational acceleration.~~